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RAPTOR RESEARCH is published quarterly in Spring, Summer, Fall, and Winter issues and occasional Supplements. The contents are usually divided into three sections. The first section is *SCIENTIFIC PAPERS* for reports of original research or theoretical analyses. These papers will be given careful editorial and referee scrutiny. A second section, *REPORTS, REVIEWS, AND OPINION*, will include secondary material, translations of material originally published elsewhere, reports of work still in progress, reports on meetings, often in some detail, book reviews, and other similar items. This material will be edited for accuracy but will not receive the critical review given the Scientific Papers. Because of the preliminary or secondary nature of the material in this section the Editors recommend that this material be cited in other papers only with great care or in a very general way and especially with specific preliminary or conference material only after consultation with the source of that information. Papers which express a personal opinion or letters to the Editor will be included in this section. *NOTES, NEWS, AND QUERIES* is used for notices of information or events, requests for information, news items either specially prepared or reprinted from other sources, and similar small items.

This journal began publication as RAPTOR RESEARCH NEWS with Volume 1 in 1967 as a quarterly in typewritten mimeographed form on an 8½" by 11" page size. Volumes 2 and 3 in 1968 and 1969 were offset printed but continued the same frequency, page size, and standard typewriter type. An analytical index for Volumes 1-3 was published. Volumes 4 and 5 in 1970 and 1971 were published six times a year in offset printing, 5½" by 8½" page size, and with IBM Composer typefaces; an analytical index for Volumes 4-5 is in preparation. In 1972, Volume 6, the name of the journal was changed to reflect the broader scope to RAPTOR RESEARCH. Currently the journal is published quarterly by offset printing with 6¾" by 9½" page size and IBM Composer typefaces and annual analytical indexes.

For membership and publication costs see inside back cover.

TECHNIQUES AND RESULTS OF ARTIFICIAL INSEMINATION WITH GOLDEN EAGLES

by
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Introduction

The techniques and some of the events involved in the successful artificial insemination and incubation of Golden Eagles (*Aquila chrysaetos*) at Cornell University during 1972 are summarized. Cooperative insemination techniques (Berry, 1972) were used primarily, as opposed to the traditional forced, massage methods normally used for poultry (see Smyth, 1968). Cooperative insemination requires birds that are imprinted to human handlers as discussed by Temple (1972). The reproductive behavior of such birds is described by Hamerstrom (1970), Temple (1972) and Berry (1972).

This project was "extracurricular" on my part, as I was busy with other research, and many of the data are not as complete as they might otherwise have been. Thus, in addition to describing techniques that worked, this report is intended to stimulate more thorough future research on some of the questions raised. Additional biological results of the work are being prepared for separate publication.

Source of Birds and Housing Methods

Four "pre-Act" (1962) adult Golden Eagles, all 10 to 12 years old, were borrowed from private owners and transported to Cornell during the summer and late fall of 1971. One of the males and one of the females were obtained originally from the wild as late eyasses. The other male and female were allegedly obtained as a brancher and a passager, respectively.

The two females were housed at the Behavioral Ecology Building in rooms measuring 10x20 feet with a 12- to 18-foot high slanted ceiling. One end of the room was open to the outside with vertical bars (thinwall conduit) to retain the birds. One-way observation windows at the other end of the room allowed the birds to be viewed undisturbed. Each room was furnished with a long perch covered with artificial grass 4½ feet above the floor, one bare tree branch three feet high, a bale of straw on the floor, a bath pan, a nest platform (3x4 feet and three feet high with heavy sticks and straw on top), loose sticks on the floor, and blocks of wood (for the birds to play with).

The two males were kept at my home on outside perches, tied with jesses

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and leashes, during the day. They were moved inside to a barn on shelf perches at night. Loose straw was placed on the floor below the shelf perches for catching mutes; the birds also used the straw for building material during the nesting period.

The males were in view of each other at all times. The females could hear but not see each other.

All four birds were fed a variety of road-killed birds and mammals, and whole chickens of various ages. They were allowed as much as they wanted to eat.

I spent sufficient time, including handling and feeding, in the presence of the birds to assure that each was well adjusted to my presence and satisfied with its immediate surroundings prior to the breeding season. Handling did not include feeding on the fist, except for two of the birds when first obtained. Food was placed near or below the perches and the birds were then either left alone or I simply sat down nearby.

All lighting was natural with care taken to insure that none of the birds was accidentally exposed to artificial light after dark.

Behavior of the Eagles and Insemination Techniques

With the onset of the breeding season, all four birds displayed courtship behavior and vocalizations toward me, constructed or attempted to construct nests with the available materials, the males gave viable semen, and the females laid eggs. The male and female showing the most vigorous and complete complements of reproductive behavior were those originally obtained as eyasses. All of the birds showed considerable individual variation in behavior.

The males copulated on my arm when I picked them up to move to a different perch. The birds showed traces of the behavior early in the season (one began 16 December) by giving a "chirpy" call and partially lowering the body on my gloved arm. Movement on my part, such as walking, would stop this behavior so I simply stood still and gave them an opportunity to copulate on my arm or shoulder each time I picked them up (Figures 1, 2). Their behavior gradually advanced (over a period of weeks) to include balling of the feet, spreading of the abdominal feathers, spreading and flapping of the wings, a loud vocalization, swinging and sideways positioning of the tail, and, finally, production of semen of variable amounts and qualities.

I collected the semen in the palm of my free hand. Semen production continued as long as I gave the birds attention and accepted copulation. One male gave viable sperm (checked with microscope) over a period of 111 days; the other male, which started later, produced motile sperm for a period of 70 days. Excluding times of only partial behavior, the birds copulated on my arm a total of 468 times, of which 216 (46%) resulted in "usable" semen (greater than 0.05 cc with motile sperm). Semen volume ranged up to 0.20 cc per ejaculate.

Secondary male sexual behavior included nest building, the typical, melodious call of the species while on the perch, more thorough plucking of prey and increased preference for eating the anterior end, a loud "yelp" call after eating while standing on the remains of the carcass (which I interpreted to be a call to

Figure 1. Male Golden Eagle copulating on arm. Note balled feet and Grier's right arm under tail to collect semen. Photograph by S. A. Temple.

Figure 2. Male Golden Eagle copulating on shoulder. Photograph by L. J. Gaeta.

the "mate" that food is available), and a voluntary release of the food at my approach. Prior to the breeding season the males typically guarded the food with "mantling" behavior at my approach.

Semen was collected from my hand into a narrow-ended blunt glass tube connected to a syringe. Semen held up to 3½ hours in the glass tube showed no visible decrease in quality (estimated percent motility). All actual inseminations with females, however, were conducted within ½ hour of obtaining the semen. Sperm were observed without dilution or staining (owing to lack of time) under a light microscope at 430x with a coverslip. When the semen was to be used, I collected it on a sterile plastic glove to prevent contamination from my hand (which was observed to reduce viability) and to prevent loss of any volume on the irregular surface of the hand. The semen was transported in the glass tube in which it was collected. This tube and syringe were carried in turn upright in a small glass tube to catch any semen that might spill out.

The behavior of the females prior to egg laying went through several stages. Both showed the same behavior but to slightly different degrees and lasting different lengths of time (days to weeks). Normal behavior of the birds during the fall and winter involved quiet perching most of the time with occasional changing of perches, maintenance behavior, and some playing with objects in the room. During early spring and lasting several weeks the birds became noticeably more playful: running about the room, pouncing on and footing objects, and jumping about with the objects with wings flapping. They also began calling melodiously at this time, although one bird (the eyass) called much more frequently and louder than the other. This was followed by a stage of working with sticks. The birds walked around, inspected and picked up sticks in their feet and beaks, and carried them haphazardly about the floor and occasionally to the nest where they would pull at them with their beaks as in plucking and eating. They made little attempt to arrange them on the nest, however.

The next type of activity was very deliberate nest building in which the birds would take sticks to the nest and carefully arrange them around the perimeter. After doing that for a few days they carried and arranged the straw lining. In the final stage they formed a "cup" in the lining both with "scraping" actions by pushing the feet backwards while in a prostrate position, similar to falcons, and by standing, turning, and arranging the straw with the beak. Later on, while incubating eggs, the females maintained the "cup" by reaching out with their beaks from the resting position and pulling straw into a mound surrounding the body.

Initial insemination of both females was with forced massage techniques. As egg laying commenced, however, one of the females (the passage bird) began posturing voluntarily for insemination. I stimulated the voluntary posture by placing one hand under her abdomen, then one hand on her back while standing beside her (Figure 3). She would droop the abdominal feathers, bend forward, lower and spread her wings, raise her tail, and evert the cloaca, into which the semen was then injected. She accepted insemination voluntarily most readily on days *prior* to laying an egg and least readily the day following egg laying.

For forced insemination I held the female the first time we did it. That caused her to be upset at me and she would not allow me to approach her for about a day until she gradually accepted me again. For all remaining inseminations an assistant, strange to the bird, picked the female up. This resulted in the birds' being upset at that person without any interference in my relationship with them.

Forced inseminations were accomplished as follows: The assistant entered the room and picked the bird up on a gloved fist. The bird showed no resistance to that person the first time, but thereafter she had to be caught first. When the bird bated on its own accord it was lowered and placed on the floor on its breast. I then entered the room from behind so that the bird could not see me and took its legs in one hand. The assistant then massaged the abdomen and prolapsed the oviduct. I used my free hand to inject the semen. Then the assistant took the legs again; I left the room; he released her on the floor; and he left the room. The inseminations required a total time, once the bird was caught, of one minute or less.

The birds were generally inseminated the day following the laying of each egg except for the one female that began accepting inseminations voluntarily; she was inseminated almost daily. One forced insemination after a nine-day interval without laying was done (unintentionally) just seven hours prior to laying an egg. The egg was not damaged in the handing, although the pigment of that egg was much more blurred than on others, possibly resulting from movement of the egg during the time pigment was being added. Only one of the forced inseminations occurred at a time when I estimated that ovulation might be occurring. This was followed by the nine-day gap in laying which might indicate an interference with ovulation by the handling (cf. last sentence of paragraph three paragraphs prior to this one). The long gap may, however, have simply resulted from possible recycling processes which are not yet understood in these birds. On the basis of these data I would recommend inseminating once a week, as is done with poultry, unless the bird accepts insemination voluntarily and one wants to do it more often.

To obtain more than the normal number of eggs, I removed eggs as soon as they were laid until I felt enough had been taken. One female laid four eggs, on 19 and 22 March, and 1 and 5 April; the other laid five, on 1, 5, 12, late 15 or early 16, and 19 April. No more eggs were laid after the females were allowed to incubate.

The last two eggs of the one female and the first four of the other were fertile. The fifth egg of the second female was either infertile or development stopped in the very early stages. Of the two first infertile eggs, one was laid unexpectedly before we inseminated and the other was laid 51 hours following the first insemination. One of the fertile eggs was laid nine days after the last previous potential insemination. (She was also inseminated seven hours before oviposition, as described above.) The minimum determined interval between laying was 72 hours. From these data and information from other species I suspect that the egg may spend approximately 70 hours in the oviduct before lay-

ing in Golden Eagles.

The prolonged egg laying appeared to cause progressively thinner eggshells (Table 1). However, the fifth egg from the one female appeared to have a thicker shell after calcium (powdered milk) was added to the food following the fourth and very thin-appearing egg. These results have not been compared with normal variation for the species because of the small sample size.

Table 1. Shell thickness[1] of successive eggs.

Female	Egg No.	1	2	3	4	5
Chrys		0.50	0.56	0.48	0.47	
Furious		0.61	0.59	0.58	0.55	0.59

[1]Shell and membrane, dried three months at room temperature. Measured to 0.01 mm at girth with Starrett micrometer.

Incubation and Hatching of Eggs

All but one of the fertile eggs were incubated in a forced-air incubator under standard poultry conditions (temperature 99.2-100.0 F; relative humidity 55-60%; turned 90 degrees automatically every two hours) but with cooling for 10 to 30 minutes twice a day in a room at 82 F and additional turning of 180 degrees once a day. The remaining fertile egg was left under one of the females (the eyass) which was known to incubate well. The other female incubated poorly, including this year with a substitute turkey egg.

To allow the incubating female to eat, stretch, and exercise, I exchanged incubation duties one to three times a day with her. I entered her room, she stood up slowly and left the egg, and I covered it with a cloth-covered hot-water bottle warmed to 99-101 F while I sat nearby. She ate occasionally, stretched, roused, muted, bathed occasionally, and was active in the room, including much play and footing of perches and other objects. After a variable length of time (mean of 16.5 minutes, range 4-61, with an increase toward the end) she came back to the nest (Figure 4), I removed the hot-water bottle, and she settled onto the egg.

Development of the eggs during incubation could be partially assessed by candling, but changes in weight revealed little. Under a good candling light and with practice and careful turning, the eggs initially showed a light green glow with a diffuse and indistinct shadow from the yolk in the center of the egg. By the fifth day the yolks floated higher in the egg, casting a more distinct shadow and, in the fertile eggs, showed some enlargement. The infertile egg showed no further change except for a gradual over-all darkening of the egg as it lost moisture until the fourth week when the distinct shadow of the yolk could no longer be seen. In the fertile eggs, however, the shadow approximately doubled in

Figure 3. Stimulating female Golden Eagle into copulatory posture prior to cooperative insemination. Photograph by S. A. Temple.

Figure 4. Female Golden Eagle returning to nest to resume incubation. Hot-water bottle is covering egg. Photograph by J. W. Grier.

size between the fifth and sixth days and the shadow covered the top one-third of the egg by the seventh day. From the eighth day on all that could be seen in most of the fertile eggs was a clear, distinct, and gradually enlarging air cell at the broad end of the egg with the remainder opaque. In one egg (F4) which was white and had a relatively thin shell for that female, the development of embryo and vessels was visible for several days, until that egg also became opaque.

The weight changes during incubation (Figure 5) of two eggs that hatched, one that developed until hatching, and an infertile egg, were nearly identical; the developing eggs lost weight slightly faster after about the third week. Three eggs in which the embryos died earlier in development appeared to stop losing weight after the time when the embryos were estimated to have died. The one which may not have been fertile in the first place (F5) lost the small air cell it had and appeared to gain 0.5 g over a period of seven days; a spring scale (150 g capacity) was used and the 0.5 difference may have been due to the inaccuracy of that type of scale.

The causes of death of the three embryos that died in mid to late stages of development are not known. Artificial incubation rarely achieves a complete hatch even under the best conditions; the conditions used may not have been optimal for eagle eggs; and turning, in particular, may have been inappropriate or excessive at the later stages (cf. Baerends and Drent, 1970, and remarks by W. Nelson at 1971 and 1972 RRF Raptor Breeding Conferences, e.g. Nelson, 1972).

The first two fertile eggs in the incubator and the one under the female hatched after six weeks of incubation. The egg under the female "hatched" prematurely after it had just pipped and the female accidentally stepped on it. That chick's yolk sac was not completely absorbed and the blood was still circulating in the chorionic vessels. Hence, in the absence of the accident, it probably would have hatched the following day. The bleeding was stopped by clamping the umbilical cord, the yolk sac was pushed into the abdominal cavity, and the umbilicus was sutured closed (Figure 6). Development of the other two was complete at hatching but they had to be helped from the shells after signs of weakening at 43 and 34 hours after pipping. The problem in hatching appeared to result from dried membranes and, in one case, may have been complicated by a very small egg (C3) in which the chick was unbelievably packed. The latter chick's head was pressed out of normal symmetry (which gradually became normal after hatching) and it appeared unable to rotate in the egg.

I used a large, essentially empty, forced air hatcher for the first hatching. The second was transferred to a still-air hatcher full of other hatching eggs but after it had already pipped and possibly so late that the membranes may have already started drying. The chicks appeared to be stimulated into vigorous activity and cheeping whenever the hatching eggs were moved or the door was opened to add wet sponges for increased humidity. Part of the drying problem may have been due to inadequate external stimulation during active hatching, resulting in a prolonged hatching period and greater opportunity for drying than would

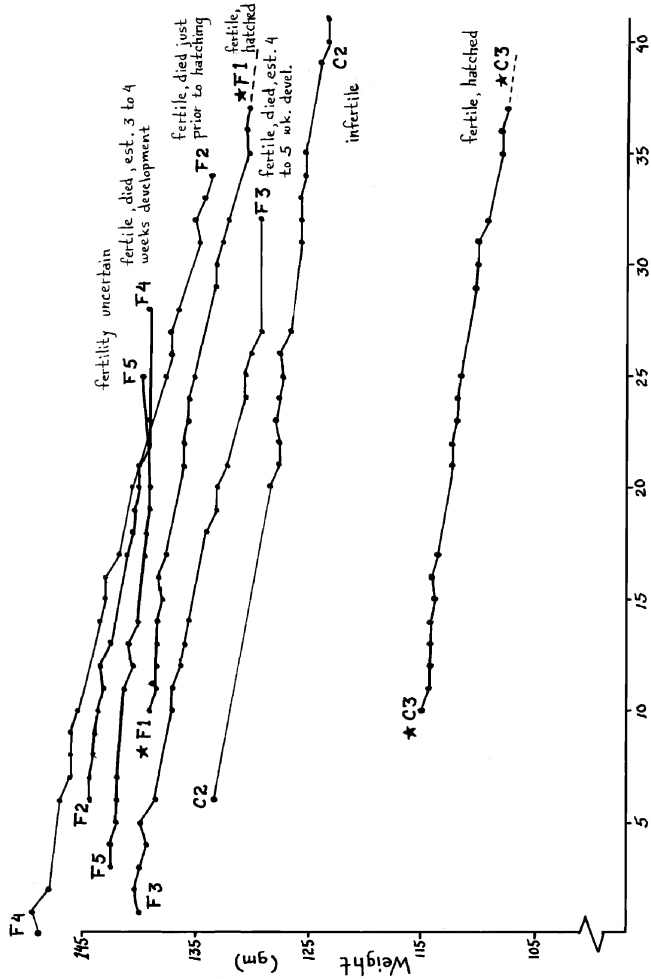

Figure 5. Weight changes of eggs during artificial incubation.

occur under a bird. Other potential factors may have been sub-optimal incubating conditions resulting in weaker chicks and lack of possible direct help by the parent bird. For comments on hatching-help behavior by adult birds see Buhler (1971).

Initial Rearing of Chicks

After hatching, the chicks were kept in the hatcher until the down was fluffed up (aided by rubbing with cotton) and they had rested. The chicks were then taken to my home where they were given constant surveillance. Feeding was determined by their food-begging and by watching the quality of their mutes. Since hatching had been assisted in all three cases and the chicks were considered weak, initial feedings were assisted by force feeding. The first feedings were given eight, five, and 17 hours, respectively, after hatching. The latter, premature chick still had much yolk and was not ready to eat as soon after hatching as the others.

"Brooding" temperatures for the chicks were determined by their behavior (see below) and varied slightly between the different chicks. Their preferred ambient temperature was approximately 32 C initially and decreased almost daily. I used a light bulb adjusted to different heights over an open box for heat control. This worked well for controlling the temperature but the lowered humidity and or direct radiation resulted in gradual dehydration of the chicks. I would recommend instead a more closed container initially with a heating wire or covered light bulb for heat and a pan of water for increased humidity (cf. Snelling, 1972).

The chicks gave three different basic vocalizations: one for food-begging, one for discomfort (too hot or cool), and a mad chitter when more distressed. When comfortable the chicks would sleep quietly and relaxed. When too warm they would extend their wings and neck, then start to cheep, move about, and pant. When too cool they would tuck all extremities close to the body then start to cheep and shiver. They became too warm very easily.

After the incubating female broke the pipped egg but while she was still incubating a substitute egg, one of the other chicks was given to her, at five days of age. She essentially ignored the chick, however, and it had to be removed. The problem may have been due to a number of factors. The female may have lost interest in incubating/brooding; the chick may not have behaved appropriately as a result of not being hatched and initially brooded under a bird. In addition, the female may have been upset by the presence of a strange assistant at the nest to help substitute the egg (while I was working with the chick from the broken egg), even though the female showed no outward signs of being upset by the assistant.

Outcome of 1972 Insemination Work

Two of the chicks were scheduled for fostering out to wild eyries in Colorado but they died in transit from accidental overheating. The remaining chick was nearly lost in the same mishap but survived, recovered, and is alive and well in

Figure 6. Newly-hatched Golden Eagle chick resulting from artificial insemination. This particular chick was premature (see text). Note sutures in umbilicus. Photograph by J. W. Grier.

Figure 7. Surviving immature Golden Eagle resulting from 1972 artificial insemination at Cornell University. Photograph by J. B. (Jerry) Grier.

my care at the time this report was prepared (Figure 7). The chick was hand reared, tame hacked (cf. Hamerstrom, 1971), and is imprinted to humans.

As a concluding remark on the light side, I might add that, although I have not yet been charged with polygamy, I am probably the only individual, man or bird, to have successfully mated with four eagles in one season.

Acknowledgments

I would like to thank L. Gaeta, Fran Hamerstrom, and M. Schweig for the loan of the adult eagles. Dr. T. J. Cade generously provided housing space at the Behavioral Ecology Building, some of the food, and some of the funds (through the Peregrine Fund and N.S.F. Grant GB-31547), as well as encouragement throughout the course of the work. Assistance with insemination and other handling of the birds was provided by J. D. Weaver, S. A. Temple, Phyllis Dague, M. MacLeod, and my wife, Joyce Grier. Dr. A. Bensadoun, Onalee and C. B. Ganong, R. E. Reynolds, J. Skinner, and F. Ward provided valuable advice and assistance on incubation and hatching. Incubation and hatching were conducted in facilities of the Cornell Poultry Science Department and the New York Department of Environmental Conservation. Dr. T. J. Cade, Fran Hamerstrom, and S. Temple provided valuable discussions and comments during the preparation of this manuscript.

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DO HAWKS FEED DURING MIGRATION?[1]

by
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One question frequently asked by audiences at talks given about hawk migration or when watching a flight for the first time is, "Do hawks feed during migration?" I suppose the question arises naturally. The sight of thousands of raptors parading majestically across the sky or hearing that the total number of hawks seen in migration may exceed 60,000, creates a mental image of a horrendous slaughter of everything from small birds to rabbits along a relatively narrow migratory pathway. I have assured them, generally, that the majority of hawks seen on the Duluth Flyway probably does not feed during the migration flight.

On being asked the same question this year I found it necessary to qualify my statement because of our 1972 observations. I was further brought up short by Dr. Harrison Tordoff, James Ford Bell Museum, University of Minnesota, who said, "Of course they eat during migration. Migrations sometimes last for several weeks." What we were considering, of course, were two different kinds of migrations and migrators. I was considering not the total migration period, but the period of actual movement–not the time held up by unfavorable flying conditions, but flight from one point to the next under favorable conditions. Furthermore, I was considering mostly soarers, such as *Buteos* which dominate the Duluth Flyway. He was considering total migration involving thousands of miles. Though we are in general agreement about this point, the 1972 fall migration of Red-tailed Hawks (*Buteo jamaicensis*) has influenced me to reconsider the general question of hawks feeding on migration.

Normally, migration patterns of typical soarers and typical flappers are quite different with respect to possible hunting during migration. On a day of fair to good flying conditions soarers do not ordinarily appear until well into the morning, when thermals begin to form. Small groups rise out of the valley below, forming small kettles that move slowly away from the lookout in a generally southwest direction. As the day progresses larger kettles form at higher altitudes. Movement along the cloud streets is direct and rapid. In general flights are strongest between 0930 and 1600 hours Eastern Daylight Saving Time. On a particularly good day this may start earlier. I have seen strong flights of 100 or more as late as 1830 hours. During this time no general hunting behavior is shown, either in the morning prior to the inception of the flight, or in the evening when the major portion of the flight has ended.

As for flappers (accipiters and falcons mostly): while the flight seems to be

[1]Contribution No. 3 of the Hawk Ridge Nature Reserve.

directional and purposeful, it is frequently interrupted by the quick dash of a Sharp-shinned Hawk (*Accipiter striatus*) at a resting flicker, or the maneuverings of an American Kestrel (*Falco sparverius*) as it snatches a dragonfly out of the air to eat while still flying along its migration path. It seems to be well-known that trappers do best with accipiters and falcons, fair with Red-tailed Hawks, and most poorly with migrating Broad-winged Hawks.

The behavior of Red-tailed Hawks during the 1972 fall flight was quite different from normal. In particular, September and early October birds frequently hunted along the ridge as they moved in their flight. The frequency was sufficient for several observers to note and comment on it. Even the presence of considerable numbers of observers along the hillside did not significantly alter their hunting behavior. Attempted strikes and occasional kills were sometimes made directly in front of observers. Broad-winged Hawks did not show the same behavior, although four immatures were caught by banders. Golden Eagles (*Aquila chrysaetos*) were also noted hunting the area, the first time I have seen that during migration. Two were caught on the ridge. We watched another make a terrific stoop at a Red-tailed Hawk. One of the two eagles caught bore a partially-healed gunshot wound, which may have had some effect on his behavior.

In short, at least Red-tailed Hawks and, perhaps, Golden Eagles did not conform to what we recognize as the normal pattern of migrational behavior.

C. J. Pennycuick's comparison of soaring versus powered flight (*Ibis* 114: 178-218, 1972) has shown that a large bird in powered flight uses more energy than a smaller bird, and soaring, therefore, has more effect on the fuel consumption of a large bird than a smaller one. With an initial fat buildup it is possible for a bird adapted to soaring to travel for days without refueling. Powered flight is characteristic of accipiters and falcons, although they can soar. It may be that flappers need to refuel more often than soarers.

In 1972, Red-tailed Hawks may have been unable to start with the necessary fat reserves. Thus, they found it necessary to refuel along the way. Without the necessary banding information it is only speculative, but our best deductions indicate that the massive Goshawk invasion of 1972 was triggered by a shortage of the normal food in their breeding grounds. It is possible that Red-tailed Hawks also suffered from the same food shortage. The more versatile Broad-winged Hawks suffered less. Their patterns were not changed to the same degree as the patterns of larger raptors and powered flyers.

It is my belief that "normal" migration behavior of soaring hawks shows no regular pattern of hunting, once the flight is under way. Hunting becomes part of the pattern only when the flight is delayed by inclement weather or when the initial fat build-up is not sufficient to sustain flight for the necessary time. Powered flight may require more frequent refueling and powered flyers may respond to fortuitous prey. This is not difficult since small bird flights often occur at the same time, over the same paths. However, even here the flight for many is not interrupted once it is under way.

Manuscript received June 15, 1973

REPORT:
CURRENT RESEARCH ON ACCIPITERS

Compiled by
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Steve Hennessy, PO Box 199, Logan, Utah 84321. Beginning (1973) a study of the effects of recreational activities upon nesting Cooper's Hawks as well as other aspects of accipiter biology. Also testing an auditory method of censusing nesting pairs. Master's study.

Alan Jenkins, 1460 East 520 South, Provo, Utah 84601. Planning to study Goshawk nesting using a time-lapse super-8 movie camera.

J. D. McGowan, Alaska Department of Fish and Game, 1300 College Road, Fairbanks, Alaska 99701. In 1970 the ADF&G initiated studies on Goshawks. Objectives of the program were to assess density and productivity of Goshawks in Interior Alaska. A light aircraft was used to locate potential nesting areas. Active nests were monitored to determine productivity. A total of 25 active nests have been monitored on the 170 square mile study area during the three years of study. Trapping and banding operations have resulted in the handling of 122 Goshawks since 1970. Additional data were collected including growth and development of young, fall movements, molting of adults, morphology, summer food habits and behavior of nesting adults. The ADF&G plans to continue Goshawk studies through the fall of 1973 after which the published data will be available for further investigation by University of Alaska graduate students.

Joseph Platt, Department of Zoology, Brigham Young University, Provo, Utah 84601. Conducting a nesting study of Sharp-shinned Hawks by means of telemetry. Both adults were followed daily from the hatching of the eggs until the young left the area three weeks after fledging.

Richard Reynolds, Oregon Cooperative Wildlife Research Unit, Oregon State University, Corvallis, Oregon 97331. Just completed a four-year study of resource partitioning among the three accipiters in Oregon during the breeding season. Beginning in spring 1973, three additional years will be spent determining nesting densities in areas where the three species coexist, differential migration, partitioning of resources during winter, and elucidating several questions raised during the first four years of research. Ph.D. study.

Charles Schwartz, Department of Biology, Idaho State University, Pocatello, Idaho 83201. Planning a study and analysis of Cooper's Hawk breeding behavior utilizing both field observations and captive pairs. Two-year Master's study.

Noel and Helen Snyder, Box 21, Palmer, Puerto Rico 00721. Have completed four years of a continuing study of the ecology and behavior of accipiters in the southwestern United States. The study covers nesting ecology of the three species, reproductive behavior of adults, behavior of young, growth and development, productivity, population trends, diet by sex and as a function of point in the breeding cycle, and diet as a function of altitude. Some experiments were done on hunting rates as a function of brood size with both natural and manipulated numbers of young, and of the ontogeny of the pecking response to red in young accipiters and how this response may relate to eye color changes in adults. About 70 eggs were analyzed for chlorinated hydrocarbons and heavy metals. The population will continue to be monitored and banded for several years to determine dispersion of young, age of first banding, longevity and related matters.

L. G. Swartz, College of Biological Sciences and Renewable Resources, University of Alaska, Fairbanks, Alaska 99701. With students work has involved trapping, biopsying, banding, and releasing Goshawks for about three years in order to supplement whole-body pesticide data gathered from dead hawks brought in by the public and donated by the Alaska Department of Fish and Game. A relatively low level cooperative effort with the studies of J. D. McGowan and the Alaska Department of Fish and Game is expected to increase in importance beginning in 1973 when more intensive work on nesting and movements is planned.

REPORT:

RAPTOR RESEARCH BY THE BUREAU OF SPORT FISHERIES AND WILDLIFE

[The following brief summaries of Bureau research projects are taken from a 20-page report entitled "Ongoing Research Projects Concerned with Nonhunted and Urban Birds." In at least 20 of the 77 projects listed raptors were the sole or important objects of the research. A number of other summaries relating to raptors to a lesser degree included: Development of Nationwide Breeding Bird Surveys, Study of Bird Migration and Distribution, Interaction between Birds and Man, Use of Return Data on Banded Birds, Study of Importation of Birds into the United States, Manual for the Identification of Endangered Species of Birds, Mortality of Birds Related to Human Activity, Importance of Dead Trees and Snags in the Ecology of Forest Environment in the Southwest, and some others.—Editors.]

Bird and Mammal Laboratories—Washington, D. C.

Geographical Limits of Racial Populations of the Bald Eagle

Objectives: To determine the limits of morphological variation of breeding populations of the Bald Eagle by geographical area throughout its range, with special reference to the endangered southern population.

Progress: Specimens in the National Museum and those alive or frozen for autopsy at Patuxent which were believed to represent breeding populations were measured. Lack of specimens from critical breeding areas such as the Lake States has hampered progress.

Systematic Status of Some Hawaiian Endemic Endangered Species

Objectives: To clarify the taxonomic position (at species or subspecies level) of Hawaiian Hawk, Coot, Gallinule, etc. Many of these forms have not received a systematic review since their original descriptions 75 to 100 years ago.

Progress: Measurements and other pertinent data are being gathered at various museums as opportunity permits.

Denver Wildlife Research Center—Denver, Colorado

Ecology, Life History, and Dynamics of Selected Wildlife Species—Golden Eagle Studies in the Southwest

Objectives: To develop a method of inventory of Golden Eagles in S. W. and determine index of abundance from annual transect counts. Make a survey of nesting status of the Golden Eagle along Front Range of Rockies. Determine

productivity of Golden Eagles in New Mexico, Colorado, and Wyoming.

Progress: Inventory methods developed and studies continuing.

Patuxent Wildlife Research Center–Laurel, Maryland

Preliminary Survey of Rare and Endangered Birds and Their Habitats in the Hawaiian Islands

Objectives: To organize available information on endangered wildlife in Hawaii into readily usable form; to gather information on current status; assess relative importance of principal environmental characteristics limiting each species.

Progress: Accumulation of information from literature in a punch card system is now essentially complete; current information on Hawaiian Crow, Hawaiian Hawk, Hawaiian Stilt obtained; studies of the Kilauea-Keauhou (*Acacia koa*) forest, a type of great importance to endangered species, were initiated; intensive studies of the endemic forest birdlife of Kauai has produced some valuable observations including the first known nesting of the Oo.

Life History, Ecology, and Management of the California Condor

Objectives: To obtain information on population status, life history, and ecology additional to that supplied by Koford and Miller *et al.*, to provide a factual basis for management.

Progress: Additional information on population status, nesting activity, roosting, effects of disturbance, effects of pesticides, food supply and plumage changes was obtained.

Status, Life History, and Ecology of Threatened Wildlife of the Southeastern United States

Objectives: To determine the present status, distribution, life history, and ecological requirements of the Florida Everglade Kite and Dusky Seaside Sparrow.

Progress: A population of about 120 kites was found. Their distribution and nesting success depends on water levels which control snail activity. Sources of kite mortality both natural and human were investigated. Fresh water inundation for mosquito control on Merrit Island Refuge has caused decline of salt marsh habitat with accompanying reduction of Dusky Seaside Sparrows.

Cooperative Wildlife Research Units

Ecological Investigations of the Gyrfalcon in Alaska

Objectives: To investigate the breeding biology and ecology of the Gyrfalcons of the Seward Peninsula. To assess the chlorinated hydrocarbon pesticide contamination in these birds and their prey species.

Progress: Analyses for chlorinated hydrocarbon pesticides are continuing on both falcons and prey species collected. Eggshell thickness has been measured

and indices calculated. DDE comprises about 90 percent of residues and residues were high in some cases. Eggshell thickness does not differ significantly from prepesticide indices. Great individual variation in DDE residues as determined by fat biopsies reflect differences in individual feeding habits. Population recruitment good in 1970, nearly zero in 1971 and increased again in 1972.

Nesting Density and Reproductive Success of Prairie Falcons in Southwestern Idaho

Objectives: To determine population size and density, productivity, nesting success, mortality, and food habits.

Progress: In 1972, 101 nesting pairs located and 47 nests were studied. One hundred and forty-seven young were banded. Egg clutch sizes determined. Interaction with Peregrine Falcon noted.

Effects of Prefledging Experience on Pair Formation and Nest Site Selection in Raptors

Objectives: To test feasibility of using nest site imprintation in female raptors as a means of inducing breeding in captivity.

Progress: Kestrels are being raised in artificial nest structures of several types and they will be offered a choice of nesting structures during the first year of breeding.

A Survey of Prairie Falcon Populations in Western Montana

Objectives: General study to determine population density and productivity in selected areas of Montana.

Progress: Two and one half year study completed and thesis completed in June 1972. Found Prairie Falcons reproducing satisfactorily but were being affected by pesticides in two counties in southwest Montana.

Behavior of the Golden Eagle during the Breeding Season

Objectives: To study ontogeny of behavior in eaglets and the adaptive significance of sexual dimorphism in adults.

Progress: Study in third year and should be terminated in one year with Ph.D. thesis.

Management-oriented Study of Bald Eagle Concentration in Glacier

Objectives: To determine numbers and behavior of eagles in Glacier Park during spawning season of Kokanee salmon and to make recommendations for protection of birds while allowing limited viewing by visitors.

Progress: Will continue field work during 1972 and complete thesis in 1973.

Breeding Experiments with Golden Eagles in Captivity

Objectives: To utilize crippled or confiscated eagles brought to unit for study.

Progress: Most of these birds are rehabilitated but a few are kept for captive breeding experiments.

Life History and Habitat Requirements of Burrowing Owls in Western Oklahoma

Objectives: To determine preferences for habitat for nesting, escape, feeding, and shelter, to describe life history and determine if migratory.

Progress: Thesis now being revised.

Osprey Production, Nest Site Selection, and Food Habits on Deschutes National Forest, Oregon

Objectives: Measure productivity of breeding pairs and determine population trends; evaluate nesting habitats particularly as to nest site selection to provide guidelines for timber harvest; determine species of fish taken for food and frequency of capture.

Progress: Thesis in preparation.

Breeding Biology of Accipiter Hawks in Oregon

Objectives: Determine clutch size, hatching, and fledging success of Goshawks, Cooper's Hawks, and Sharp-shinned Hawks breeding in Oregon; Evaluate levels of persistent pesticides in eggs, moribund young and selected prey items.

Progress: Eggs of Cooper's, Sharp-shinned and Goshawk collected and sent to Cornell University for quantification of DDE content. Breeding Pairs of Cooper's Hawk spaced 3.5-4.0 miles apart; Goshawks about 12 miles. Difference in habitat appears to be age structure of forest at nest site.

Ecology of the Northern Spotted Owl

Objectives: Habitat requirements, limits of range in Oregon, reproductive biology, food habits, effects of forest management.

Progress: New Project. Planning and field reconnaissance begun.

Division of Wildlife Refuges

Southern Bald Eagle Nesting on Merritt Island National Wildlife Refuge

Objectives: To determine what proportion of eagle nests are producing young and number of young produced per nest; to gain information on nest failures.

Progress: Continuing.

Habitat Requirements of Apple Snail (*Pomacea paludosa*)

Objectives: Because of the indispensability of this snail as food for the endangered Everglade Kite, to determine its distribution in Lake Woodruff Refuge; determine the vegetative and water characteristics where it is most abundant; determine the water depth preferred by snails for feeding and resting during day and night; determine all life history factors necessary for the management of this snail.

Progress: Continuing. Since 1971, one report completed.

Autumn Survey of Migrating Peregrine Falcons on Assateague

Objectives: To monitor the abundance and calculate age and sex ratios of migrating Peregrines and compare these conditions with previous records; to standardize the methods of compiling population indices so that data obtained will provide meaningful baseline information; to trap and mark Peregrines to determine breeding and wintering areas of Assateague migrants.

Progress: A manuscript on Autumn migration of Peregrine Falcons on Assateague Island 1970 has been submitted for publication in *The Auk*.

BOOK REVIEW

Hamerstrom, Frances. 1972. *Birds of Prey of Wisconsin.* Madison: Wisconsin Department of Natural Resources. 64 p. 6x9". Numerous sketches by Elva Paulson. Paper Covers.

Birds of Prey of Wisconsin is different from any regional account of birds of prey you have ever read. It is *not* true to the mold with lengthy plumage descriptions, county-by-county documentations of specimens and observations, and an inflexible format of data presentation. Instead, each species account focuses on one or more interesting attributes of the birds. Life histories, field characters, and status in Wisconsin are woven into easily-read, informative narratives. Introductory pages deal with hawk migration, vernacular names, reading field signs, raptor silhouettes, and a field key to Wisconsin's hawks, vultures and eagles. Even seasoned raptor biologists will find jewels of information during a casual evening's reading of Mrs. Hamerstrom's new book. *Richard R. Olendorff.*

NOTES, NEWS, AND QUERIES

Publication Date of Winter Issue, 1972. Volume 6, Number 4, Winter, 1972, of *Raptor Research* was published December 18, 1973.

Conference on Raptor Conservation Techniques, Fort Collins, Colorado, 22-24 March, 1973. Nearly 200 persons attended this very successful and stimulating meeting which was sponsored by the Raptor Research Foundation with the Department of Fishery and Wildlife Biology of Colorado State University and the Colorado Division of Wildlife as cosponsors.

The editorial work on the Proceedings of the Conference are well advanced. Part 1, an introduction, and Part 2, the raptor ecology session, are ready for publication in the next issue of *Raptor Research.* The introduction will include a general account, a list of the papers on the program, and a list of Conference participants. Papers in the ecology session which were submitted for publication will be printed and there will be a section including abstracts of other papers given and an edited transcription of the informal discussion. Part 3 on the management of raptors is set up in type and after proof reading by authors, will be printed as soon as possible, as a separate number in our *Raptor Research Report* series. Part 4 on raptor populations is being prepared for another number in *Raptor Research Report;* primary editing is practically complete and typesetting will begin any day. Parts 5 and 6 on techniques and rehabilitation and pathology will be treated like the ecology session, in the fall and winter 1973 issues of *Raptor Research.* With the exception of the very large population section, all are scheduled for publication before the Spring 1974 issue of *Raptor Research* in March.

North American Hawk Migration Conference, Syracuse, New York, April 19-21, 1974. Valuable research on hawk migration has been done by many individuals and organizations over the past 40 years, but little work has so far been done to correlate these studies. The purpose of the North American Hawk Migration Conference, therefore, is to gather under one roof hawkwatchers from all over eastern North America–from the edge of the Great Plains at longitude 95 degrees east to the Atlantic coast, and from Manitoba to the Gulf of Mexico–to exchange observations on hawk migration, to set standards for record-keeping, and to agree on ways of sharing and collating information on a continuing basis. The Chairman of the Planning Committee is Michael Harwood,

Box 51, Washington, Connecticut 06793. The Program Chairman is Pershing B. Hofslund, Department of Biology, 221 Life Science Building, University of Minnesota, Duluth, Minnesota 55812.

The conference will be held at a Holiday Inn north of Syracuse, which is easily reached by interstate highways and is also served by trains, buses, and airlines. Registration will begin the evening of Thursday, April 18; the program will begin the next day and end late Sunday. Conferees who stay at the Holiday Inn can expect to pay about $15-$20 a night per room, plus $3-$6 a meal. The Onondaga Audubon Society has formed the host committee for the conference, and the host committee chairman, Dorothy W. Crumb (3983 Gates Road North, Jamesville, New York 13078), will be able to answer any questions you may have about transportation and accommodations.

The working list of subjects to be covered includes the following.

The mechanics of bird-of-prey migration—what gets them started, what points them in the direction they take—and unanswered questions about this.

Major weather patterns and their effects on migration (including a meteorologist's discussion of weather patterns) and more unanswered questions.

Local weather conditions that are subject to rapid change, and local topography, and the effects of both on migration routes; unanswered questions here, too.

Problems of bird-of-prey identification; if the weather is right, this may include a trip to nearby Derby Hill at the southeastern edge of Lake Ontario—a first-rate spring hawkwatch.

The limits of sight: how far away can birds be seen with the naked eye, and how greatly is this range extended by binoculars and telescopes?

The use of radar in counting and tracking birds of prey.

Trapping and banding migrating birds of prey.

Possibilities and techniques for discovering where the birds of prey are coming from: where are they breeding?

Finding and opening new lookouts; proselytising and training new hawkwatchers.

Developing new kinds of data on migration behavior by keeping records of more than the count of passing hawks.

Setting standards for the record-keeping, and exchanging information regularly.

We do hope that you will attend the conference and that you will encourage other hawkwatchers to join us. *(From the Conference Planning Committee flyer.)*

RAPTOR RESEARCH FOUNDATION, INC.
in care of Biology Department
University of South Dakota
Vermillion, South Dakota 57069
U.S.A.

The **RAPTOR RESEARCH FOUNDATION, INC.** is a non-profit corporation whose purpose is to stimulate, coordinate, direct, and conduct research in the biology and management of birds of prey, and to promote a better public understanding and appreciation of the value of these birds.

Publication has been a major area of activity. From 1967 to 1971 *Raptor Research News* was published; in 1972 publication was continued under a new name, *Raptor Research.* A series of occasional longer publications was started in 1971, *Raptor Research Report. Raptor Research Abstracts,* initiated in 1972, is a quarterly bibliographic service.

The Raptor Research Foundation has had a number of informal meetings and in 1971 sponsored the first of its conferences on specific topics on raptors. This one was entitled "Special Conference on Captivity Breeding of Raptors," and another planned for 1973 is entitled "Conference on Raptor Conservation Techniques."

The interests of the Foundation are indicated by the titles of its committees: Editorial, Captivity Breeding, Population, Banding, Bio-telemetry, Pathology, Pesticide, Ecology and Ethology, Systematics, Education and Conservation, Bibliography, International Coordination, and Finance and Investment.

MEMBERSHIP

Membership in the Raptor Research Foundation is open to all who contribute. *Raptor Research* is sent to all who contribute a minimum of $3.00 per year; those who wish to receive both *Raptor Research* and *Raptor Research Abstracts* must contribute a minimum of $5.00. These minimal rates have been established to encourage all who are interested to join. Other activities are financed by the generosity of members who contribute more than the minimum. Such contributions are encouraged.

PUBLICATIONS

All previous publications are still available.

Raptor Research News each issue 50 cents.
1967-1969, Vols. 1-3, 4 issues each; Analytical Index, Vols. 1-3– 50 cents.
1970-1971, Vols. 4-5, 6 issues each; Vol. 5, issues 5-6 combined, $1.00.

Raptor Research Report No. 1, Richard R. Olendorff, "Falconiform Reproduction; A Review. Part 1. The Pre-nestling Period." February 1971, 111 pp., 6" x 9", $2.50 ($2.00 to members).

Additional copies of current issues of *Raptor Research* are $1 each. For price of additional copies of the Supplements, apply to Raptor Research Foundation.